elongated. The alveolar process of the old man is oblique, but the upper part of the face is vertical, and the facial angle is very open. The forehead is wide, by no means receding, but describing a fine curve; the amplitude of the frontal tuberosities denotes a large development of the anterior cerebral lobes, which are the seat of the most noble intellectual faculties. If the Cromagnon Troglodytes are still savages, it is because their surrounding conditions have not permitted them to emerge from barbarism; but they are not doomed to a perpetual savage state. The development and conformation of their brain testify to their capability for improvement. When the favourable opportunity arrives, they will be able to progress towards civilisation. These rough hunters of the mammoth, the lion, and the bear, are just what ought to be the ancestors of the artists of the Madelaine.

I have just glanced over the principal facts in the history of the Troglodytes of the Vézère. For want of time, I have been obliged to shorten several and omit a number more. I hope, nevertheless, that you have been able to follow with me from Moustier to Cromagnon, from Cromagnon to Upper Laugerie and Gorge d'Enfer, and from thence finally to the three stations of the Eyzies, Lower Laugerie, and the Madelaine; the progressive evolution of an intelligent race, which advanced step by step, from the most savage state to the very threshold of civilisation. The Troglodytes of the latest epoch had, so to speak, but one step to take in order to found a real civilisation, for their society was organised, and they possessed arts and industry, which are the two great levers of progress.

This people have, nevertheless, disappeared, without leaving a single trace in the traditions of man. They did not die off by degrees, after having passed through a period of decadence. No, they perished without transition, rapidly, perhaps suddenly, and with them the torch of the arts was suddenly extinguished. Then began a dark period, a sort of middle ages, the duration of which is unknown. The chain of time becomes broken, and when we seize it again, we find, in the place of the reindeer hunters, a new society, a new industry, a new race. They are beginning to understand agriculture, they have some domestic animals, they are raising megalithic monuments, they have hatchets of polished flint. It is the dawn of a new day; but they have lost every remembrance of the arts. Sculpture, drawing, ornamentation, have alike disappeared, and we must descend to the later period of polished stone to find, here and there, on the slabs of some very rare monuments, a few ornamental lines which have absolutely nothing in common with the remarkable productions of art among the Troglodytes. The extinction of the Troglodytes was so complete and so sudden that it has given rise to the hypothesis of an inundation; but against this geology protests, and, to explain the phenomenon, we need only refer to the influence of man himself. Our peaceable reindeer-hunters, with their gentle manners, their light weapons, which were not adapted for fighting, were not calculated to resist the invasion of barbarians, and their growing civilisation succumbed at the first shock, when powerful conquerors, better armed for war, and already provided perhaps with the polished hatchet, came to invade their valleys. It was then seen, as it has often since been proved, that might conquers right.

PROF. FLOWER'S HUNTERIAN LECTURES

LECTURES XVI. XVII. XVIII.

ARTIODACTYLATA. The peculiarities of the skeleton in these animals have been already pointed out; it may be added as a constant special character, that the lower end of the fibula articulates with the calcaneum as well as with the astragalus; the premolars are also simpler than the molars, and there is an extra lobe to the last milk molar. The number of existing species is very great; they tend to divaricate in two directions, one culminating in the Pigs, and the other in the Cavicorn Ruminants. The Hippopotamus and Chevrotain at first sight do not look much alike, but the links between the two are very complete. The existing species are the most differentiated members of the order. Of the *Suina*, the Pigs are very exceptional among existing mammalia in retaining the typical number of forty-four teeth, Gymnura, an insectivorous animal, alone resembling them in this point; however there are spaces between some of them, so they do not form a regular series. The upper canines are very peculiar in being directed upwards instead of downwards, and in the Babirussa, where they pierce the upper lip, this is carried to an extreme. The molars are tuberculated, the tubercles being four in number in the Peccary, but much more numerous, especially in the last molars of *Sus*, where the extra ones represent the third lobe of the same teeth in the Ruminants. In a fossil pig from Pikermé the canines were similarly developed in both sexes, so the sexual differentiation must have been of later origin. In the Wart-hogs the incisors are rudimentary, and late in life the only molars persisting are the enormous columnar last molars; the great size of the canines is well known.

In the true *Ruminantia* there are no upper incisors, and the canines are but rarely developed. In the lower jaw there are eight teeth in a row along the front of the mouth, the two lateral can be proved to be canines, because in older types they are found of a different shape from the six true incisors. The anterior premolar is never developed. Kowalevsky has recently given the names *Bunodont* and *Selenodont* to the non-ruminating and ruminating members of this class, on account of the differences exhibited by their molar teeth, those in the latter presenting the ridges as a double crescent instead of in tubercles. The temporal bone and its surroundings give excellent characters whereby to separate these sub-classes; the shape of the glenoid cavity and the direction of the external auditory meatus differing considerably in them. There is also no lateral notch in the palate of the pigs like those in the Ruminants. The Cervidæ and Cavicorn Ruminants also have the odontoid process of the axis peculiarly spout-shaped, whilst in the pigs it forms a simple peg, much as in man. It does not seem to have been remarked before that in this respect the *Tragulidæ* differ from the typical Ruminants, and resemble the pigs, the odontoid in them being a peg. With regard to the feet of *Sus*, Dr. Kowalevsky has made some important observations, having shown that the approximated sides of the two median metacarpals, which are the largest, send in towards one another processes which interlock, and that the shape of their distal articular surfaces causes them to be pressed together when the foot is to the ground. In the pigs the fibula is separate and complete, but in the Ruminants it is represented only by a small piece of bone outside the ankle; a rudiment is sometimes present above. That the deer approach the original type more than do the antelopes is evident from the facts that the upper canines are sometimes present, the crowns of the molars are shorter, and the lateral toes are present, being best developed on the fore-limb. The *Tragulidæ* are less differentiated in having the anterior metacarpals free and the fibula entire, though slender; the canines are well developed in the male at least, and the glenoid cavity is as like that of the pig as of the deer. *Dicotyles* approaches the ruminants from the other side, the metatarsals uniting to form a canon bone, and the foot altogether closely resembling that of Hyomoschus, though an outer toe is lost in the former. The camels are developed in a different direction, approaching the more generalised type.

Artiodactylates appear first in the middle Eocene, and therefore do not go so far back as the Perissodactylata.

Anoplotherium is from the upper Eocene of France and England only; there are two or three species. Though so early a form, it was much specialised, and its peculiarities have not been retained in more modern nor existing forms. It was about the size of the ass. The teeth formed an unbroken series, and, as in man, they were uniform in height. The upper molars were much as in Palæotherium, and the lower were a modification of the same type. Nineteen dorso-lumbar vertebræ were present; the tail was very long, with large chevron bones, which are not found in other Ungulata, and from which Cuvier somewhat rashly inferred that the animal was aquatic. The odontoid process of the axis was simple. In the feet there were only two toes before and behind; the metacarpals were quite separate. In one species there were four toes in front and three behind. *Elotherium* or *Entelodon* is another form from the lowest Miocene. It has been found in the middle of France and in the Mauvaises Terres of Dakotah. Its skull was elongated and somewhat pig-like, but the orbit was completed behind by bone. In size it approached the tapir. The teeth were somewhat carnivorous, the canines being long and bear-like, and the premolars trenchant; the forty-four teeth were present; the posterior molars were comparatively small, and the last one in the lower jaw had scarcely a rudiment of a third lobe. As in Anoplotherium there were only two toes on each foot, and the metacarpals and metatarsals were free.

Of the *Suidæ* many fossil species are known; the first appear in the upper Miocene of Eppelsheim and Pikermé, those in the latter locality much resembling the existing forms, the teeth only being less differentiated. There are no fossil true pigs in America. In the earlier and middle Miocene of Germany and France close allies are found in abundance, with the teeth simpler, only four tubercles being present, and the last molar not being excessively developed. One of these, *Amphichœrus*, had very long canines pointing downwards in the upper jaw. *Hyotherium* comprises *Palæochœrus* and *Chœrotherium*, the latter a small animal described by Leidy. There is a perfect transition between Palæochœrus and the fossil true pigs. Going further back it is doubtful how the line of descent continues. Acertherulum of Gervais may have had some relation to it. The American peccaries are peculiar in having only three premolars; in the fore-foot the outer toe is much reduced, and in the hind foot it is lost; a canon bone is formed by the metatarsals. Fossil peccaries have been found by Lund in Pleistocene caves of the United States, and in the American Miocene, scattered teeth of pig-like animals are not uncommonly met with.

Of recent hippopotamuses there are two species which have been further separated into different genera by Leidy, *Chœropsis* being the smaller and more pig-like; in it also the teeth are not so complicated, and it has two fewer lower incisors. In both genera the molars are very characteristic, being raised in four cusps, each of which in the little worn tooth is trefoiled on the surface; as the tooth gets more used these run together to form ultimately a single insula, undulated at the borders. In the Pleistocene caves and gravels of England, France, Germany, and elsewhere, remains of *Hippopotamus amphibius* are numerous, some are larger than existing individuals, but they do not otherwise differ. In Sicily a smaller species is found in enormous numbers. There are no hippopotamuses in the Miocene nor in the lower Pliocene. In Madagascar a smaller species used to abound. Dr. Falconer, in the Sevalik Hills, found remains of true hippopotamus with four incisors, but most from that region belonged to a distinct form in which all the six were present, and which has been named *Hexaprotodon*. There is no complete bridge between these animals and the pigs, and none have occurred in America.

Dr. W. Kowalevsky has drawn attention to an interesting point in the construction of the limbs of the different members of this class. He has shown that there are two methods by which the extremities may be supported on the carpus and tarsus respectively. In one, the *inadaptive*, the digits as they reduce in number, still are only supported by the carpals which originally articulated with them in the pendactylate foot. In the *adaptive* method, as the digits reduce, they enlarge their bases of attachment on the carpus, and so get a firmer support. This latter condition is found in all existing Artiodactylates except Hippopotamus.

Of the *Selenodonts* one of the earliest known is *Chœropotamus* from the upper Eocene of Montmartre; it was about the size of a pig, with the molars characteristic, presenting five tubercles, three in the anterior row, and two behind. *Anthracotherium* had similar molars, its limbs are unknown. *Hyopotamus* though but little known, was once very abundant; the species varied in size from that of a large rat to that of *Anthracotherium*: it is only found in the Eocene and early Miocene of Europe and North America. The molars were formed on the same principle as those in Chœropotamus, but they were more drawn out; the lower formed double crescents with an internal tubercle well developed; the typical forty-four teeth were present. Most had four toes, and feet very pig-like. Kowalevsky found some at Hordle with only two, and he has named these *Diplopus*. Between Hyopotamus and Anthracotherium there are many intermediate forms, *Xiphodon* with two toes, *Dichobune* and *Cainotherium*, this last had forty-four teeth, forming a continuous row, and three toes on the feet. *Dichodon* was a genus, named by Owen from some teeth, of which it possessed the full number, and the molars formed double crescents. From this we pass by easy transitions to the *Tragulidæ*, which have nothing to do with the Musk-deer, as is so frequently stated. They are at present confined to South Africa, South India, and the adjoining large islands. *Hyomoschus*, the African genus, has survived almost unchanged from the early Miocene period. *Tragulas* is not known fossil.

An American group here comes in to fill a gap. *Oreodon*, an animal about the size of a sheep, found in the early Miocene, is said by Leidy to be quite intermediate between the deer and the peccaries. It had forty-four teeth, its palate more closely resembled that of the deer, and the upper molars formed, as in them, double crescents. The canon bone was not consolidated, and there were apparently four toes. They closely resemble Dichodon. Leidy divides them into three genera, *Agriochœrus*, *Merychyus*, and *Oreodon*. The first of these approaches Chœropotamus, and the crowns of the teeth were very short. *Gelocus*, described by Kowalevsky, is the earliest known form in which the metacarpals coalesced to form a canon bone; it occurs in the Eocene and the earlier Miocene. Those from the former have the metacarpals always free, but in the Miocene they anchylosed in the adult animal, and in higher strata they are fully coalesced. *Dremotherium* was a form which closely approached the deer. *Cervus* proper is first represented in the upper Miocene. In the earliest forms the antlers were very small and simple, closely resembling those of the Muntjac, and having long pedicles; the canines were also developed. All the Cervidæ adhere to the old type in having short crowns and well-marked necks to their molars. The Giraffes (*Camelopardidæ*) are first known from Pikermé and the Sevalik Hills; the molar teeth more closely approached those of the deer than any other animals. *Heladotherium* is not far removed from them; it was of large size and had no horns. *Sivatherium* was the largest of the extinct Artiodactylates. Its bones were bovine in character; the metacarpals and metatarsals coalesced to form a canon-bone, and there were only two toes on each foot; four horns were present, in pairs, apparently cavicorn and yet branched.

Antelopes and Deer coexisted in the Miocene era, but most of the former are Pleistocene in date. The crowns of the molars are prolonged in all the cavicornia. The *Camels* are not directly allied to the other forms; they retain an upper incisor; their molars are in double lunules, and of considerable length. Their geographical distribution is very peculiar, they being confined to North Africa, Arabia, and South America. Dr. Falconer has found their remains in the Sevalik Hills, and Leidy has done the same in North America, naming one of his genera *Procamelus*, and another earlier one Poëbrotherium.

This ends the description of the Artiodactylata, and terminates the course of lectures.

AN ENGINEERING COLLEGE IN JAPAN

THE Japanese Government, as represented by the ambassadors who visited this country last summer and autumn, have resolved upon taking example by our western civilisation, and establishing a college in the city of Yeddo for affording instruction in civil and mechanical engineering to the youth of Japan, as a strong desire has arisen in that country to make an effort to develop the great natural resources which it is known to possess. Our advice and practical assistance in the establishment of the college have been called into requisition, owing to the ambassadors having observed during their sojourn amongst us, how intimately our eminent industrial status as a nation is dependent upon the attention which we devote to the cultivation of those sciences which are involved in the mining, metallurgical, engineering, and many manufacturing industries, and in bringing the forces of nature under the influence of man.

The general scheme of the instruction has been devised by one of our eminent engineers, a gentleman whose experience of Continental and British systems of instruction is very extensive and varied, and judging from the appointment already made, it is evident that the professorial equipment of the college will devolve upon this country. The principal of the college, who is also to be the professor of engineering and mechanics, is Mr. Henry Dyer, M.A. B.Sc., who studied at the University of Glasgow, under the late Prof. J. M. Rankine, Sir William Thomson, and their colleagues. Mr. Dyer was a Whitworth Scholar, and his career hitherto has been one of great and well deserved success. He is well qualified to act as principal of the Yeddo Engineering College.

Prof. Dyer is to be assisted in his duties in the Japanese College of Engineers by professors of mathematics, natural philosophy, chemistry, geology, and mineralogy, and by teachers of English, &c. At least two important appointments have been made, namely, to the professorship of mathematics and to the professorship of natural philosophy. The former has been conferred on Mr. D. H. Marshall, at present assistant to Prof. P. G. Tait in Edinburgh University; and the latter is to be filled by Mr. W. E. Ayrton, formerly of University College, London, and the University of Glasgow. The last-named gentleman has already been employed in the East Indian telegraphic service, and he is at present assistant-engineer in connection with the manufacture of the Great Western Telegraph Cable under Sir William Thomson and Prof. Fleeming Jenkin.

In connection with this Engineering College there are several other points of importance that may be stated. It is intended to institute a geological survey of Japan, and not improbably the active superintendence of that work will devolve upon the gentleman who may ultimately be appointed to the professorship of geology and mineralogy. As an important adjunct to the College, there will be erected a technical workshop, fitted with steam-engine, machine tools, and all the necessary appliances for familiarising the young Japanese engineers with the principles of construction, &c. There will also be a technological museum for the illustration of the progressive stages of various industrial processes from the raw materials to the finished products.

NOTES

LETTERS, dated St. Thomas, appear in the *Times* and *Daily News* from correspondents on board the *Challenger*, where the vessel arrived on March 16. The voyage from Teneriffe had occupied 30 days. The usual programme was to furl sails early in the morning of every alternate day, put the ship under steam, obtain a sounding-haul of the dredge and serial temperatures at every 100 fathoms from the surface down to 1,500 fathoms, then at dusk sail was again made. The sounding line and dredge have been kept constantly going. The former showed that a pretty level bottom runs off from the African coast, deepening gradually to a depth of 3,125 fathoms at about one-third of the way across to the West Indies. If the Alps, Mont Blanc and all, were submerged at this spot, there would still be half a mile of water above them. Five hundred miles farther west there is a comparatively shallow part, a little less than two miles in depth. The water then deepens again to three miles, which continues close over to the West Indies. At the deepest spots both on the east and west side of the Atlantic, the dredge brought up a quantity of dark red clay, which contained just sufficient animal life to prove that life exists at all depths. No difficulty was experienced in obtaining these deep-sea dredgings, and it was merely a question of patience, each haul occupying twelve hours. In depths over two miles little has been found, but that little was totally new. One of the lions of the cruise is a new species of lobster perfectly transparent. Not content with obtaining animals with eyes so fully developed that the body may said to be an appendage, a new crustacean has now dredged up, in which the body has cut itself clear of the eyes altogether, and the animal is totally blind. It has no eyes, or even the trace of an eye. To make up for its deficiency nature has supplied it with the most beautifully developed, delicate lady-like claws, if one may use the term, it is possible to conceive. Nearer the West Indies, in a depth of only half a mile, some similar creatures were brought up, and here the claws, longer than the body, are armed throughout with a multitude of spike-like teeth, looking more like a crocodile's jaw than anything else. At a short distance from Teneriffe, in a depth of a mile and a half, a rich and extremely interesting haul of sponges and coral was obtained, but the latter was unfortuately dead. It is a white species, as large and heavy as the pink coral of the Mediterranean. There are great hopes of obtaining a specimen alive. The nature of the bottom brought up and the way the trawl and dredge frequently catch in being dragged along prove, undoubtedly, that the bottom of the sea, even at great depths, is not so smooth and free from rocks as has hitherto been supposed. A conclusion drawn from this fact is that a considerable movement of the water at the bottom must be going on. The *Challenger* will remain at New York until the 25th of April, and at Bermuda until the mail arriving on the 8th of May, after which she will sail for Madeira, carrying another section line across the Atlantic.

WE have learnt with pleasure that it is contemplated to present a testimonial to Dr. Murie, in recognition of his numerous additions to our knowledge in the field of Biology. From a list before us we learn that Dr. Murie is the author of seventy-five separate works, large and small, mostly connected with zoology. An opinion having been expressed that it might not be inappropriate to present Dr. Murie with a substantial recognition of the services which he has rendered to science by his numerous